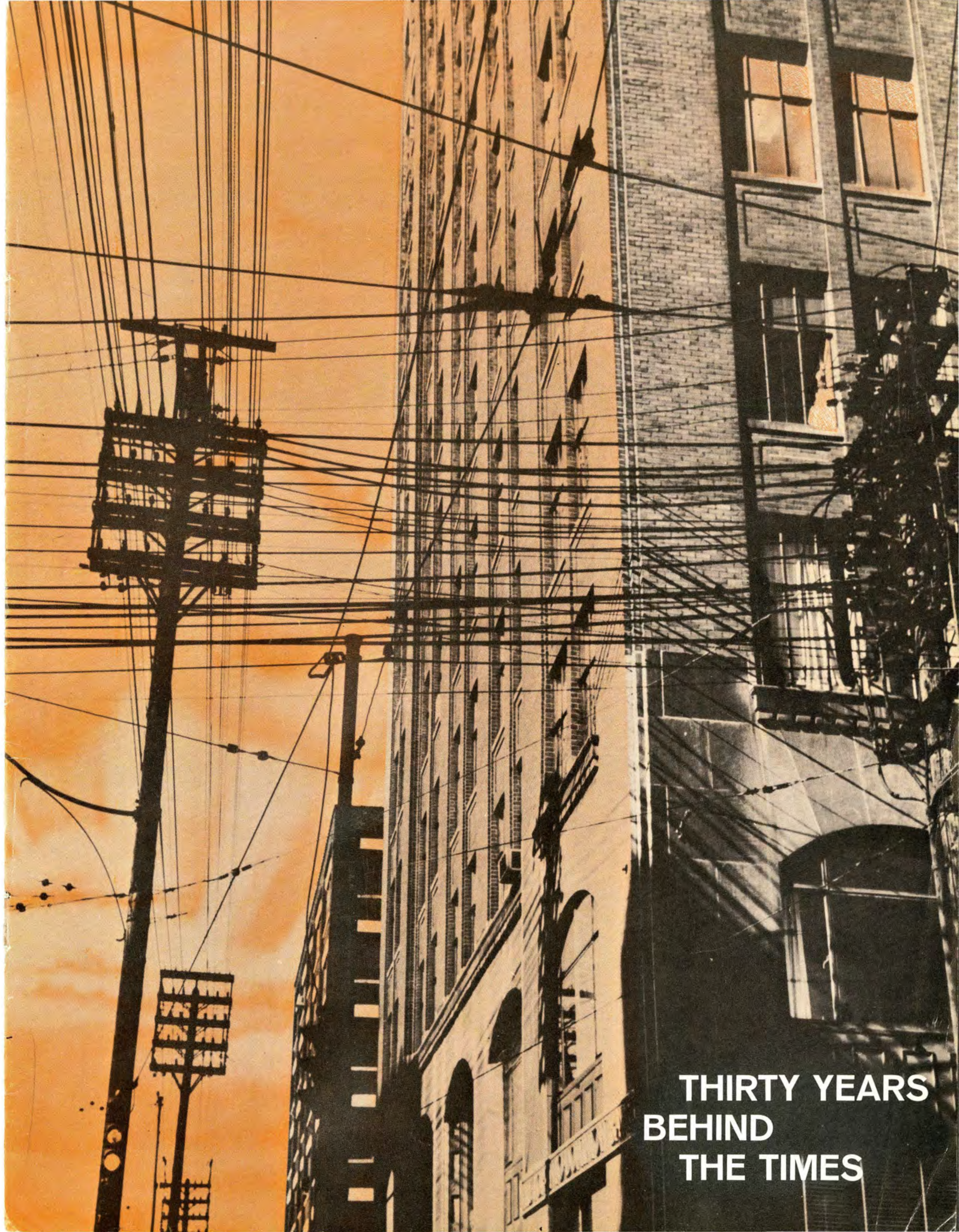

THIRTY YEARS
BEHIND
THE TIMES

THIRTY YEARS BEHIND THE TIMES

The streets of downtown areas of Canada's major cities are festooned with the unsightly heritage of the past, a jungle of poles strung with tangled wires in a snarled maze of interwoven cables. The clean lines and modern shapes of buildings created by Canada's leading architects are marred by the confusion below. Shopping malls and smart stores conduct their business beneath this Edwardian canopy, and even in the well-planned suburban housing developments, the streets are still defaced by millions of feet of aerial wiring.

Canada's rapid growth has resulted in urgent demands by burgeoning industry for ever increasing supplies of power. Domestic demands too have risen apace, for in the fifties a million dwellings were built in this country. Cities have grown by ten percent every year with sixty percent of the population now living in the cities. This immense upheaval of society has transformed Canada from an agrarian economy into an industrial complex, while the Royal Commission on Canada's Economic Prospects predicted that in the 1957-1982 period, some 3.7 million more houses would be built. A study by the Royal Architectural Institute indicated that Calgary, Edmonton, London, Toronto, Montreal, Vancouver and Ottawa-Hull will each more than double their housing by 1970 and the last three will triple it.

Professional Building and Planning Organizations

This restless striving is creating a national awareness of the need to equate aesthetic values with the material considerations of the environment in which we live. Now is the time to pause, to take an objective look at our cities and towns. We must plan future developments carefully and improve existing facilities in a way that truly reflects the needs and feelings of the people.

Architects and town planners realize that it will take years to implement good planning in the cities as they exist today. However, these professional bodies are highly vocal in their disapproval of the ugly maze of overhead wiring and make strong demands for its placement underground. Also, it has long been recognized that with increases in the standard of living, domestic consumption of electrical power rises. Existing distribution systems must be expanded to satisfy rising demands, further complicating above-ground structures. But the public is now showing strong interest in the alternative underground system, and many new home purchasers request this form of servicing.

Canadian planners are not an arm of local government and are only able to make recommendations on a consultative basis. In the U.K. and continental Europe, planners and local authorities have recognized the necessity for placing wiring underground wherever possible and nearly all towns from a few thousand population up, have this form of service. European cities are completely free of overhead wires, and all their power and communication supply is buried. The U.K. has probably the longest and closest association with the supply and distribution of electrical power at all system voltages and many of their conclusions to place services underground are applicable to this continent.

The Trend to Underground Cabling

While it is true that overhead lines are cheaper than underground cables, there are a number of additional and indirect cost factors which place the balance in favour of underground cable. This assumes particular import in developed areas where population and industry are so densely concentrated that overhead wires pose a dangerous hazard to life and limb.

- Many aerial distribution networks in business and industrial sections are at saturation point and to match rising load growth becomes impossible.
- Further construction of high voltage overhead lines in urban and semi-rural areas is fraught with ever-increasing costs and difficulties.
- Prior to construction, extensive preparatory work is necessary with a considerable amount of time and money expended in obtaining right-of-way and then surveying and mapping contour profiles of routes.
- The great upsurge in air-borne traffic, too, must now be taken into consideration in planning future routes and construction form.

These difficulties will increase in years to come and there is no doubt that underground cables will be used to a greater extent even outside towns and cities.

This grim aspect of an older district in Toronto holds dangers, in the event of fire, for the Fire Department when erecting aerial apparatus.

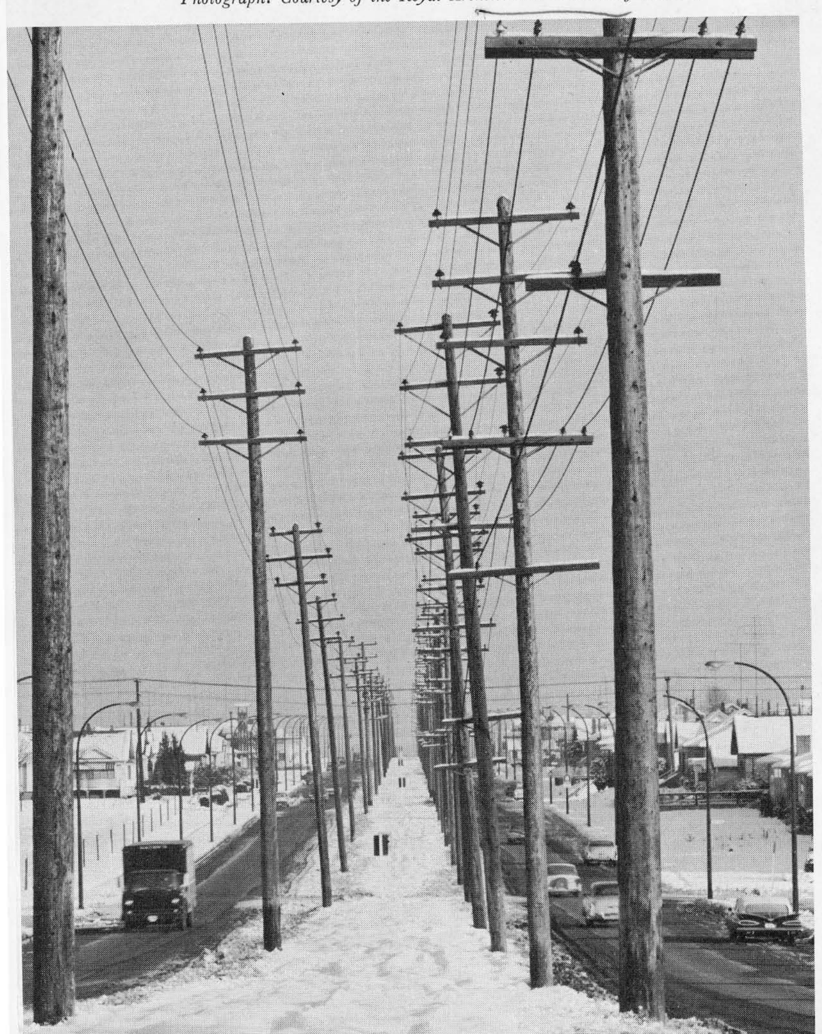
Photograph: Courtesy of the Royal Architectural Institute of Canada.

Even in a well-planned residential area, the streets are still defaced by millions of feet of overhead wiring. The neat appearance of this sub-development and care taken by residents, is spoilt by untidy poles and wires.

Photograph: Courtesy of the Royal Architectural Institute of Canada.

This median strip is a cluttered corridor of power poles.

Photograph: Courtesy of the Royal Architectural Institute of Canada.



In contrast, is a similar highway median strip with all wires buried.

Photograph: Courtesy of "Civic Administration"

In strong contrast is this suburb. All wiring is buried and its absence contributes to an over-all attractive appearance. Street illumination follows a predetermined, ideal pattern instead of being forced to coincide with the positioning of power poles.

Photograph: Courtesy of "Civic Administration"

Difficulties in the acquisition of land have been a contributing factor in the decision to place the Vancouver City 230 kV ring main, underground.

Disadvantages of Overhead Wiring

In the case of overhead installations, with a life expectancy of only 30 years as opposed to the 40 years or more of underground cables, the high rental or purchasing cost of land adds considerably to the annual capital charges. Overhead lines are subject to severe mechanical stress and are continually exposed to varying climatic conditions, requiring routine line patrols involving appreciable staff and transport cost, to replace innumerable line components with comparatively short, reliable working lives. Apart from these predictable items of line maintenance, the unforeseen chance elements of severe storms can cause widespread and costly damage with subsequent loss of revenue and goodwill to the utility. In addition there are the incidental dangers to traffic and public from downed high tension wires. The work of the fire departments too, in erecting aerial apparatus is seriously hampered by poles and lines. Summer storms frequently cause shutdowns from lightning on lines of all but the highest voltage, while underground cables are completely free from this form of damage because of their natural protection.

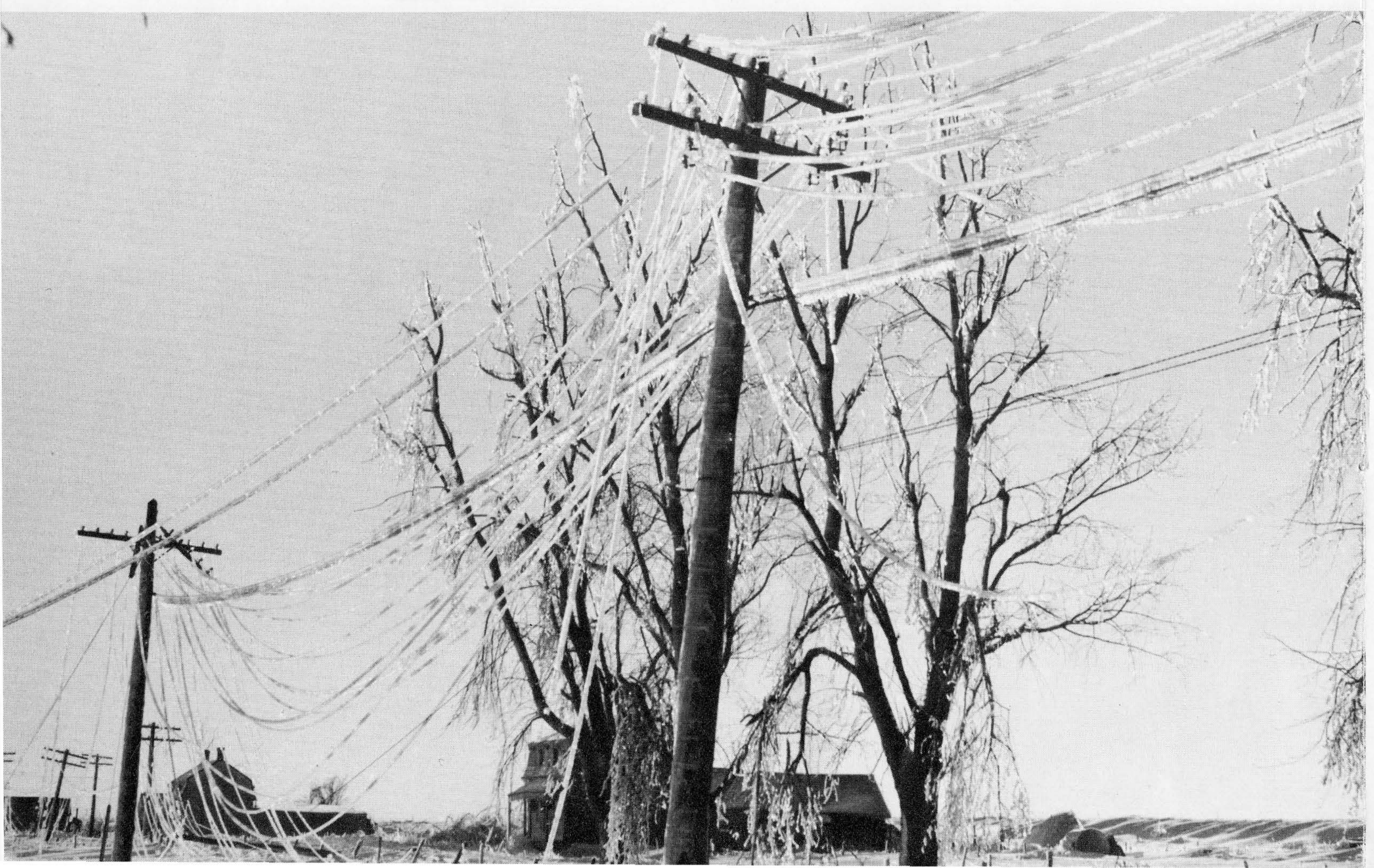
These planning costs and hazards are the prime responsibility of the utility concerned, but they have additional obligations particularly in the case of property owners. It is readily demonstrable that areas served by underground cables retain higher values because of greater aesthetic appeal, than those possessing overhead wiring.

Research and Development

Cables are not the major cost factor. It is rather the expense of burial that brings up the over-all operation charges. The copper conductors used have the unique advantages of strength, lightness, ease of fabrication in joining and will effectively conduct electricity as long as the insulation remains sound. Old cables have been reclaimed with the insulation completely broken down, but with the copper conductors still in excellent condition. For these reasons the use of copper conductors which ensure a minimum dimension, produce the most economical cable.

The use of progressively higher voltages has involved long and costly research into the problems of insulation and conductor servings include various layers of impregnated paper, rubber, bitumen soaked compounds and steel wire armour. But now numerous technological developments including the introduction of inexpensive, inert plastics as insulation are reducing manufacturing costs and effectively increasing cable life; while greater efficiency attained by use of ma-

The disastrous effects of ice. Consider the maintenance costs and disruption of essential consumer services.



chines in trenching operations and conduits with additional space for projected cables, have vastly reduced over-all installation expenditure.

Present Activities

Steps are now being taken by some of our more progressive cities to place their systems underground.

- In Quebec City an underground wiring project is being developed on Charest Boulevard, one of the busiest lower town arteries.
- Quebec Power is undertaking the installation of underground wiring at Park Horizon, a new housing project in suburban Ste. Foy.
- Ottawa City and Ottawa Hydro have prepared a plan where each party contributes to a special fund for a period of five years to finance underground cabling projects.
- Improvements have recently been made in the London area in residential underground wiring with excellent co-operation on the part of the consumer.
- The British Columbia Hydro and Power Authority is completing a six-year program in Victoria to give that city the first pole-less downtown area for any Canadian city of its size.
- Stratford is proposing to place overhead wiring underground; the cost being borne by revenue derived from the Shakespearean Festival.
- In Toronto, new housing developments feature servicing by underground cables as an important selling incentive.

Standards for Residential Underground Wiring

In the District of Qualicum, Eastern Ontario*, a housing development using an 8-kV underground distribution system has been influential in establishing a set of standards for underground construction.

This development consists of 160 homes and for estimation purposes it was assumed that one in every four houses would be heated electrically. To carry the load a larger size conductor than was absolutely necessary, was installed to cope with any unforeseen power demands and also to be capable of carrying the total load of the sub-division in the event of cable failure near one end of the loop feed. It was also estimated that the slight extra cost of a larger conductor size was far cheaper than installation of larger sizes later on. The present and probable future load demands were met by use of No. 1/0 copper primary conductors, rubber insulated with concentric neutral and neoprene jacketed, suitable for direct burial.

Careful planning ensured that all forseeable system breakdowns were catered for and that facilities existed for rapid resumption of service—in the case of transformer failure, a spare 75-kVa transformer was installed on a standby basis.

A small sketch showing location of all buried cables on a particular property was posted close to the service entrance of every home with the warning not to dig post-holes or plant trees in those areas.

*See addendum

Underground Cables in the City

The most progress by far in the elimination of city overhead wiring has been made by the city of Montreal with a total of 1,800 miles of cable now safely underground. The body responsible for this figure is the Montreal Electrical Commission who are maintained by provincial statute. Composed of three professional electrical engineers the Commission is busily engaged on the removal of overhead electrical wires from 950 miles of city streets.

Extensions to the system are carried out by two methods. The first being the block method where several streets are constructed as one district and the second being the artery method where electrical services are placed underground ahead of the streets on either side.

This latter method is particularly valid for single important streets or traffic arteries.

Every year a tentative list of streets and areas is compiled and submitted to the Board of Commissioners by the Chief Engineer.

Justification for construction of underground facilities is determined by the following conditions:

1. Density of population and importance of the commercial and industrial activities that will result in high power consumption.
2. Construction of new power sub-stations and addition of facilities around existing ones.
3. Improvement and widening of traffic arteries and repairing of streets. Repaving of cuts after conduits have been laid is highly expensive; so great savings may be made if these two operations are meshed.
4. Improvement of city street lighting system.
5. Renovation of downtown areas.

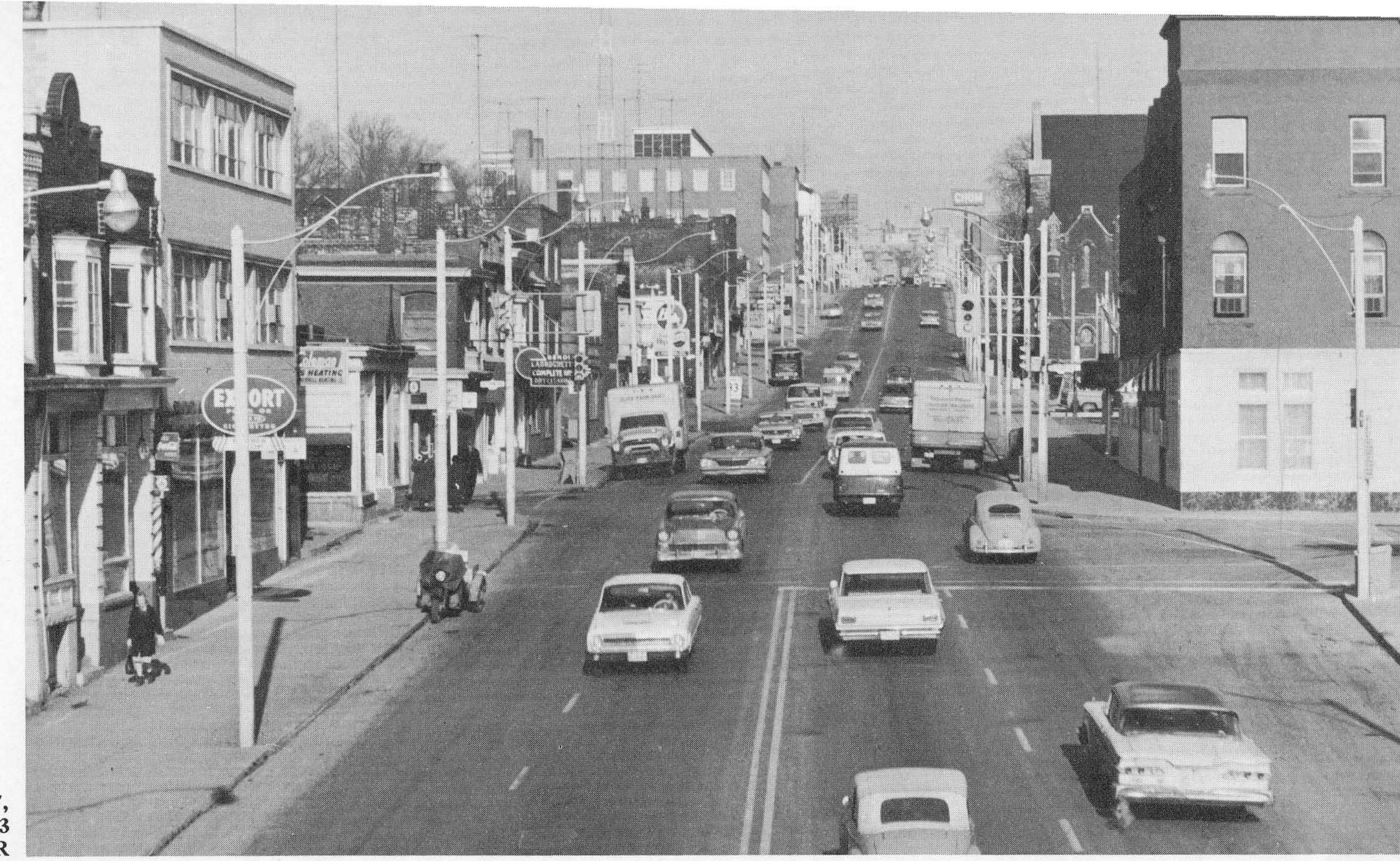
Prior to construction, exploratory work is undertaken to determine all factors influencing route selection. The location of existing surface and sub-surface structures are accurately plotted and the type of soil and depth of rock if any, analyzed. In urban areas involving both the supply of primary and secondary power to consumers, consideration must be given to location of duct runs because of the existing services of gas and water utilities. Inspectors familiar with the requirements of house wiring, closely supervise this stage of installation.

All construction work is carried out by contractors working under supervision of the Commission's inspectors. Manholes and transformer vaults are built

August 21,
1947
BEFORE

Only 15 years ago an overhead tangle of wires was thrust into the sky by wooden poles marching up Yonge Street hill, north of CPR tracks, Toronto.

January 17,
1963
AFTER



Now, slim concrete standards line and light a clearer civic vista.

Photographs: Courtesy of the "Globe and Mail"

In many industrial areas, aerial distribution networks are at saturation level. Any expansion of existing systems to satisfy rising demands for power, increases already prevalent dangers to life and property.

Photograph: Courtesy of Imperial Oil Limited

first, with the manholes generally occurring at intervals of 400 feet—the extreme limit for cable pulling is around 500 feet. Ducts linking manholes and transformers consist of a mass of fibre pipes held in place by concrete spacers and encased in concrete. Service ducts to houses, to concrete bases for lighting standards, or linking underground networks to adjoining aerial networks are mostly single or dual duct runs. They may either radiate directly from the closest manhole, or as is more often the case, branch off at a large angle from the main duct run between manholes.

In order to finance the undertaking, the law authorizes the city to issue bonds or debentures payable in not less than 40 years; the proceeds of these loans being used to construct and establish the conduit system. The system's operating expenditures and debt costs are financed from the rentals collected from the lessees. 74.5% of the duct space is reserved for this purpose and according to a Privy Council judgement, the rental must be sufficient to defray the cost of the entire system.

Today, Montreal boasts the most extensive underground distribution network of any Canadian city. Covering close to 164 miles of street, this network consists of 8,000 manholes, 700 transformer vaults and 17,800,000 duct feet.

Advantages of Underground Cables Over Overhead Wires

- *Longer Life Expectancy*
  More than 40 years as opposed to 30 years.
- *Reduced Maintenance Costs*
  Components have longer operating lives.
- *Service Uninterrupted by Storms*
  Protected from lightning, high winds and ice.
- *Easier Street Cleaning*
  Absence of poles greatly facilitates cleaning, especially of snow in winter.
- *Reduced Fire Insurance Premiums*
  Fire Department no longer hampered in erecting their apparatus by overhead wires and poles.
- *Improved Street Lighting*
  Lighting systems may be made more flexible instead of mounting only on power poles.
- *Source of Revenue*
  Spare conduits may be leased to other parties.
- *Prevention of Accidents*
  Dangers to public from fallen poles and live wires eliminated.

And the improved appearance of the streets speak for themselves, at the same time helping to maintain property values.

Ottawa, Canada's Capital City. The clean lines of modern architecture are obscured by the confusion below.
Photograph: Courtesy of the Royal Architectural Institute of Canada.

Conclusion

It has been demonstrated that the pressing need for underground cabling is not prompted solely by aesthetic reasons, but those of necessity as well. The rapid growth of towns and cities, the expansion of industry, quickly multiply the existing aerial tangle. Many downtown areas in cities across the nation are now at saturation level. At this point the economics of the two different systems become comparable no longer, for it is a physical impossibility to erect further aerial networks to carry increasing loads and without adding to the already prevalent dangers to the public and property. If economic comparisons were still applicable, the havoc created by sudden storms amongst overhead wires and poles would completely offset any immediate financial advantage. This situation has been recognized by some of the more progressive authorities with their farsighted projects to place overhead wiring underground. Now the need is for recognition of the problem on a national basis, to help build the Canada of tomorrow.

Even though poles are not visible, the beautiful lines of Saint Raphael Church, Jonquiere, Quebec, are disturbed by overhead wiring.

**Addendum—Residential Underground Cable Installation: District of Qualicum, Eastern Ontario.*

Construction work such as trenching, back filling with sand, preparation of forms and pouring of concrete pads, was done by the builder under the supervision of the utility. The builder with men and equipment on site could do the job far more quickly and cheaply than the utility. To facilitate construction and working accuracy, a map of 1 inch to 20 foot scale was prepared showing all necessary details of lot lines, primary, secondary, services, transformers, sectionalizors and easements.

The telephone company had agreed to joint use of the common trench, dug to a depth of 36 inches and a width of 24 inches. Primary cables were laid on a carpet of 2 inches of sand and a further 10 inches of sand backfill was laid over them. Secondary cables were then laid directly over the primaries with the telephone cables at the same level but a foot away horizontally. Service trenches were dug to this total depth of 24 inches and the telephone cables were laid along them in a similar manner. A final 4-inch layer of sand was placed over secondary and telephone cables and the excavated earth backfilled to grade.

Four-inch fibre ducts were used at road crossings to carry primary conductors and where water and sewer pipes had already been laid, the ducts were buried at a depth of 42 inches. In cases where these services had not been constructed, to obviate the possibility of breakage caused by backfill sinking, a 10-foot length of 4-inch black iron pipe was used, straddling the route of proposed water and sewer lines.

Transformers were mounted on pads of 3,000 lb. poured concrete encasing two, 2½-inch ducts for the primary compartment and three, 5-inch ducts for the secondary compartment. Bolts were set in the concrete for holding the assembly down.

Although it was estimated that 25 percent of the homes were likely to choose electrical heating systems, if supply pedestals were installed it would have meant buying a fairly heavy secondary bus of at least No. 2/0 copper for every home. Smaller conductors could be installed if individual home-owners didn't install electric heating systems, but both pedestals and expensive cabling would have been wasted. Consequently direct services from transformer to the house were installed. A 1½-inch polyethylene pipe was laid from inside the secondary compartment through the 5-inch duct to the back corner of each lot. Location of the buried pipe was marked by a 5-foot stake attached by wire. When any particular house was built and service requirements ascertained, the builder would dig a trench from the service entrance to the poly pipe and the correct size of service cable was pulled through in one continuous length from transformer to the house. To eliminate breakage at the service entrance caused by settling of the backfill, the cable was carried right through the foundation in 1½-inch conduit installed by the builder. From here the electrician could either lead the supply to the meter, through a conduit in the wall, or by flex on the inside basement wall.

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